

What is claimed is:

1. A knocking detection apparatus comprising:
spark plugs disposed in cylinders of an internal combustion engine;
ion current detecting means for detecting ion currents flowing in the spark plugs;
time-frequency transforming means for setting time intervals allowing one or more overlaps within a time from after ignition by the spark plugs to until its own cylinder or another cylinder next ignites and sampling current values of the ion currents in the respective time intervals to determine the time-frequency components thereof;
knocking detecting means for detecting knocking on the basis of the time-frequency components; and
detection control means for inputting a running status and controlling the time-frequency transforming means and the knocking detecting means.
2. The knocking detection apparatus of claim 1, wherein the time-frequency transforming means uses a short time Fourier transform to analyze frequency components.
3. The knocking detection apparatus of claim 1, wherein the time-frequency transforming means uses a wavelet transform to analyze frequency components.
4. The knocking detection apparatus of claim 1, wherein the knocking detecting means detects the occurrence of knocking

and the timing of knocking occurrence.

5. The knocking detection apparatus of claim 1, wherein the detection control means changes one or both of sampled times where the time-frequency transforming means samples ion current values in accordance with the running status of the internal combustion engine and an ion current sample number serving as the target of time-frequency transformation.

6. The knocking detection apparatus of claim 1, wherein resistance with respect to impulse noise and ion current intensity changes is raised by dividing, by a standard factor, a knocking determination equation that the knocking detecting means computes.

7. A knocking detection method including:

ion current detecting means for detecting ion currents using spark plugs disposed in cylinders of an internal combustion engine;

time-frequency transforming means for setting time intervals allowing one or more overlaps within a time from after ignition by the spark plugs to until its own cylinder or another cylinder next ignites and sampling current values of the ion currents in the respective time intervals to determine the time-frequency components thereof;

knocking detecting means for detecting knocking on the basis of the time-frequency components; and

detection control means for controlling the

time-frequency transforming means and the knocking detecting means, wherein

the detection of knocking is conducted by the detecting control means inputting a running status of the internal combustion engine and controlling the time-frequency transforming means and the knocking detecting means to determine time-frequency components from sampled values of the ion currents.

8. The knocking detection method of claim 7, wherein the time-frequency transforming means uses a short time Fourier transform to analyze frequency components.

9. The knocking detection method of claim 7, wherein the time-frequency transforming means uses a wavelet transform to analyze frequency components.

10. The knocking detection method of claim 7, wherein the knocking detecting means detects the occurrence of knocking and the timing of knocking occurrence.

11. The knocking detection method of claim 7, wherein the detection control means changes one or both of sampled times where the time-frequency transforming means samples ion current values in accordance with the running status of the internal combustion engine and an ion current sample number serving as the target of time-frequency transformation.

12. The knocking detection method of claim 7, wherein resistance with respect to impulse noise and ion current

intensity changes is raised by dividing, by a standard factor, a knocking determination equation that the knocking detecting means computes.